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TI - Optical irregularity inspecting apparatus for shadow mask of CRT, display panel, film, paper - judges quality of objects inspected from output of neural network and that of ideal value for object

IW - OPTICAL IRREGULAR INSPECT APPARATUS SHADOW MASK CRT DISPLAY PANEL FILM PAPER JUDGEMENT QUALITY OBJECT INSPECT OUTPUT NEURAL NETWORK IDEAL VALUE OBJECT

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IC - G01M11/00 ; G01N21/00 ; G01N21/88 ; G01N21/89 ; H01J9/14 ; H01J9/42

AB - J10318937 The apparatus comprises an image processor (3) which extracts characteristics of image of an object (100) to be inspected, from image output by a camera (1). A learning unit (4) produces a neural network from predetermined characteristics of the object and the characteristics of image of multiple objects, as output by the image processor. The change in characteristics of image of each object is stored in a memory (6) and is input to the learning unit and changes in neural network is performed accordingly.
- If the output of the neural network is different from ideal output value, the ideal value for object is corrected in the neural network. Based on the output of the learning unit, a judging unit (5) outputs characteristics of the inspected object, indicating whether the object is non-defective or inferior one.
- ADVANTAGE - Performs inspection automatically at high speed. Eliminates need of skill for output detection.
- (Dwg.1/9)

PATENT ABSTRACTS OF JAPAN

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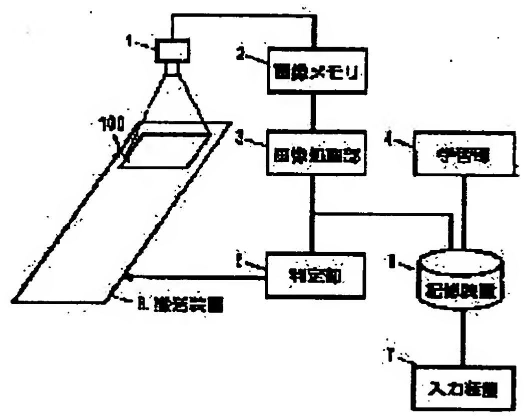
(54) OPTICAL IRREGULARITY INSPECTION DEVICE AND METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To inspect the optical irregularity of an inspection target uniformly, automatically, and speedily.
SOLUTION: An image-processing part 3 extracts the amount of feature of the image of a learning sample or an inspection target 100. A learning part 4 creates a neural network using the amount of feature and an output target value for a plurality of learning samples being stored in a storage device 6, changes the amount of feature and inputs it to the neural network, substitutes an unknown product for the output target value when the output value of the neutral network differs from the output target value, and reconstructs the neural network using the original amount of feature and the output target value after correction. A judging part 5 inputs the amount of feature of the inspection target 100 being extracted from the image-processing part 3 to the neural network and outputs the output value of the neural network as a judgment result for indicating a conforming article, a non-conforming article, or an unknown article.



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the optical unevenness test equipment and the optical unevenness inspection method of inspecting the existence of optical unevenness, such as unevenness of the concentration of an object to be examined, and unevenness of a light transmittance.
[0002]
[Description of the Prior Art] Sheet-like objects, such as a shadow mask for color Braun tubes, a display panel, a film, and paper, are manufactured so that it may have homogeneity, almost uniform concentration, or permeability. It is necessary to judge whether there is any unevenness of concentration or a light transmittance in the manufactured sheet-like object in such an inspection stage of a sheet-like object.
[0003] For example, a shadow mask is manufactured by forming many bores in a sheet metal almost periodically using the photo etching method. If the local abnormalities in a size are in many above-mentioned bores, the unevenness of a light transmittance will occur in a shadow mask. The existence of such unevenness of the light transmittance of a shadow mask is usually judged by viewing of an inspector.
[0004] In this case, even if it is the shadow mask of an excellent article, the optical unevenness of the range permitted exists. An inspector judges the quality of a shadow mask used as a subject of examination by comparing with the unevenness of the shadow mask of an excellent article which recognizes the unevenness of the shadow mask experientially, viewing the shadow mask used as a subject of examination.
[0005]
[Problem(s) to be Solved by the Invention] Advanced skill and a considerable experience are required for the judgment of the above qualities. Moreover, even if a skillful grade and experience are almost the same, the judgment result of a quality may vary according to an inspector's individual differences and health condition. Furthermore, in the judgment by viewing of an inspector, inspection takes time.
[0006] The purpose of this invention is offering the optical unevenness test equipment and the optical unevenness inspection method of being able to vary and inspecting the optical unevenness of an object to be examined automatically [there is nothing and] and at high speed.
[0007]
[A The means for solving a technical problem and an effect of the invention]
(1) The optical unevenness test equipment concerning the 1st invention invention of the 1st is optical unevenness test equipment which inspects the optical unevenness of an object to be examined, and is equipped with a storage means, a study means, an extraction means, and a judgment means.
[0008] A storage means memorizes the output desired value which shows the excellent article or defective of the characteristic quantity beforehand defined about the picture of two or more objects for study, and each object for study. A study means creates a neural network based on the characteristic quantity about two or more objects for study and the corresponding output desired value which were memorized by the storage means. Perform processing to which the characteristic quantity about each object for study is changed, and the characteristic quantity after processing is inputted into a neural network about each object for study. Output desired value is corrected by transposing the output desired value about the object for study concerned to an unknown article, when a neural network's output value differs from output desired value. A neural network is reconstructed based on the feature value of the origin about two or more objects for study memorized by the storage means, and the output desired value after correction. An extraction means extracts the characteristic quantity of the picture of an object to be examined. A judgment means inputs the characteristic quantity extracted by the extraction means into the neural network reconstructed by the study means, and outputs a neural network's output value as a judgment result which shows an excellent article, a defective, or an unknown article.
[0009] In the optical unevenness test equipment concerning this invention, the output desired value

which shows the exception of the excellent article of the characteristic quantity beforehand defined about the picture of two or more objects for study and each object for study or a defective is memorized beforehand.

[0010] After a neural network is first created using the characteristic quantity about two or more objects for study and output desired value which were memorized at the time of study, processing to which characteristic quantity is changed is performed and the characteristic quantity after processing is inputted into a neural network. When a neural network's output value differs from output desired value, the output desired value about the object for study concerned is transposed to an unknown article. Thereby, output desired value becomes three kinds, an excellent article, a defective, and an unknown article. Furthermore, a neural network is reconstructed using the characteristic quantity of the origin about two or more memorized objects for study, and the output desired value after correction.

[0011] At the time of inspection, it is inputted into the neural network by whom the characteristic quantity extracted from the picture of an object to be examined was reconstructed, and a neural network's output value is outputted as a judgment result which shows an excellent article, a defective, or an unknown article.

[0012] Thus, at the time of inspection, since the visual inspection by human being is not needed, while skill advanced to inspection and a considerable experience become unnecessary, dispersion in the judgment result by an inspector's individual difference or health condition does not arise, and a high-speed judgment is attained.

[0013] Moreover, since study is performed by making the judgment result of the excellent article by human being, and a defective into output desired value, the inspection result near judgment of human being is obtained. Furthermore, since output desired value is transposed to an unknown article when a neural network's output value differs from output desired value by correction of characteristic quantity, when the judgment of an excellent article and a defective is delicate, an inspection result called an unknown article is obtained. Therefore, the automatic judging with few incorrect judgings is realized.

[0014] (2) The optical unevenness test equipment concerning the 2nd invention invention of the 2nd In the composition of the optical unevenness test equipment concerning the 1st invention, picturize the object for study, or an object to be examined, and a picture is incorporated. It has further the picture input means given to an extraction means by making the incorporated picture into image data. an extraction means Based on the image data incorporated by the picture input means at the time of study, the characteristic quantity of the picture of the object for study is extracted. The extracted characteristic quantity is given to a storage means and the characteristic quantity which extracted and extracted the characteristic quantity of the picture of an object to be examined based on the image data incorporated by the picture input means at the time of inspection is given to a judgment means.

[0015] In this case, from incorporation of the picture of the object for study to extraction of characteristic quantity is automatically performed at the time of study, and from incorporation of the picture of an object to be examined to extraction of characteristic quantity is automatically performed at the time of inspection.

[0016] (3) The optical unevenness test equipment concerning the 3rd invention invention of the 3rd includes that the processing to which the characteristic quantity by the study means is changed multiplies characteristic quantity by the predetermined weighting factor in the composition of the optical unevenness test equipment concerning the 1st or 2nd invention.

[0017] In this case, it becomes possible by setting up the value of a weighting factor arbitrarily to perform weighting to each characteristic quantity according to the kind of the object for study, and object to be examined.

[0018] (4) The optical unevenness test equipment concerning the 4th invention invention of the 4th The neural network who sets in the composition of the optical unevenness test equipment concerning the 1st, the 2nd, or 3rd invention, and is formed of it and reconstructed by the study means It consists of an output layer containing two neurons which derive a binary output, respectively in response to the output of two or more neurons of the input layer containing two or more neurons equivalent to the number of characteristic quantity, the interlayer containing two or more neurons which undergo the output of two or more neurons of an input layer, and an interlayer.

[0019] In this case, it becomes possible to express four kinds of judgment results with the combination of the output value of two neurons in an output layer. Therefore, one of the output values of an output layer can be assigned to an excellent article, other one can be assigned to a defective, and the at least one of two remaining can be assigned to an unknown article.
[0020] (5) The optical unevenness inspection method concerning the 5th invention invention of the 5th The output desired value which shows the excellent article and defective of the characteristic quantity which is the optical unevenness inspection method of inspecting the optical unevenness of an object to be examined, and was beforehand defined about the picture of two or more objects for study, and each object for study is memorized. A neural network is created based on the characteristic quantity about two or more objects for study and the corresponding output desired value which were memorized. Perform processing to which the characteristic quantity about each object for study is changed, and the characteristic quantity after processing is inputted into a neural network about each object for study. Output desired value is corrected by transposing the output desired value about the object for study concerned to an unknown article, when a neural network's output value differs from output desired value. A neural network is reconstructed based on the feature value of the origin about two or more memorized objects for study, and the output desired value after correction. It inputs into the neural network who the characteristic quantity of the picture of an object to be examined was extracted [neural network], and had the extracted characteristic quantity reconstructed, and a neural network's output value is outputted as a judgment result which shows an excellent article, a defective, or an unknown article.
[0021] In the optical unevenness inspection method concerning this invention, the output desired value which shows the exception of the excellent article of the characteristic quantity beforehand defined about the picture of two or more objects for study and each object for study and a defective is memorized beforehand.
[0022] After a neural network is first created using the characteristic quantity about two or more objects for study and output desired value which were memorized at the time of study, processing to which characteristic quantity is changed is performed and the characteristic quantity after processing is inputted into a neural network. When a neural network's output value differs from output desired value, the output desired value about the object for study concerned is transposed to an unknown article. Thereby, output desired value becomes three kinds, an excellent article, a defective, and an unknown article. Furthermore, a neural network is reconstructed using the characteristic quantity of the origin about two or more memorized objects for study, and the output desired value after correction.
[0023] At the time of inspection, it is inputted into the neural network by whom the characteristic quantity extracted from the picture of an object to be examined was reconstructed, and a neural network's output value is outputted as a judgment result which shows an excellent article, a defective, or an unknown article.
[0024] Thus, at the time of inspection, since the visual inspection by human being is not needed, while skill advanced to inspection and a considerable experience become unnecessary, dispersion in the judgment result by an inspector's individual difference or health condition does not arise, and a high-speed judgment is attained.
[0025] Moreover, since study is performed by making the judgment result of the excellent article by human being, or a defective into output desired value, the inspection result near judgment of human being is obtained. Furthermore, since output desired value is transposed to an unknown article when a neural network's output value differs from output desired value by correction of characteristic quantity, when the judgment of an excellent article and a defective is delicate, an inspection result called an unknown article is obtained. Therefore, an automatic check with few incorrect judgings is realized.
[0026] (6) The optical unevenness inspection method concerning the 6th invention invention of the 6th includes that the processing to which characteristic quantity is changed multiplies characteristic quantity by the predetermined weighting factor in the optical unevenness inspection method concerning the 5th invention.
[0027] In this case, it becomes possible by setting up the value of a weighting factor arbitrarily to perform weighting to each characteristic quantity according to the kind of the object for study, and

object to be examined.

[0028]

[Embodiments of the Invention] Drawing 1 is the block diagram of the optical unevenness test equipment in one example of this invention.

[0029] The optical unevenness test equipment of drawing 1 contains CCD camera 1, an image memory 2, the image-processing section 3, the study section 4, the judgment section 5, storage 6, and an input unit 7.

[0030] The objects 100 to be examined, such as a shadow mask, are laid on a transport device 8, and are conveyed in the classification position beforehand defined according to the excellent article, the defective, and the unknown article according to the result of inspection mentioned later.

[0031] CCD camera 1 has two-dimensional CCD (charge-coupled device), incorporates the picture of objects for study (it is hereafter called the sample for study), such as a shadow mask for study, as image data at the time of study, and incorporates the picture of the object 100 to be examined as image data at the time of inspection. The image data incorporated by CCD camera 1 is memorized by the image memory 2.

[0032] The image-processing section 3 performs the image processing for extraction of characteristic quantity to the image data memorized by the image memory 2. That is, the image-processing section 3 extracts two or more kinds of characteristic quantity defined beforehand from the image data of the sample for study incorporated at the time of study, and extracts two or more characteristic quantity of a kind from the image data of the object 100 to be examined incorporated at the time of inspection.

[0033] Two or more kinds of characteristic quantity evaluates concentration change (concentration change on a certain line) of the horizontal shape of an overall concentration change (concentration change in latus area), length, or a line, a local concentration change (stain of a small area portion), etc., respectively, for example, and shows that the grade of optical unevenness is so large that the value of characteristic quantity is generally large.

[0034] Two or more kinds of characteristic quantity of the sample for study extracted by the image-processing section 3 at the time of study is transmitted to storage 6. Moreover, two or more kinds of characteristic quantity of the object 100 to be examined extracted by the image-processing section 3 at the time of inspection is transmitted to the judgment section 5.

[0035] An input unit 7 consists of a keyboard, and it is used in order to input the judgment result of the excellent article by the visual inspection about each sample for study, and a defective at the time of study. The judgment result inputted by the input unit 7 is saved as output desired value at storage 6.

[0036] By reading the characteristic quantity about each sample for study, and output desired value from storage 6 at the time of study, and performing study later mentioned using those characteristic quantity and output desired value, the study section 4 creates a neural network and saves the created neural network at storage 6.

[0037] The judgment section 5 judges the quality of the object 100 to be examined based on the neural network saved at the characteristic quantity and storage 6 of the object 100 to be examined which were extracted by the image-processing section 3 at the time of inspection. This judgment section 5 controls a transport device 8 according to the judgment result, and conveys the object 100 to be examined in a predetermined classification position while it saves the judgment result of a quality at storage 6.

[0038] The study section 4 and the judgment section 5 perform study and a judgment using a neural network's algorithm. The neural network is explained to Hideki Aso work "neural network information processing" Sangyo Tosho Publishing Co., Ltd., Inc. issue (1988) in detail, for example.

[0039] In this example, storage 6 is equivalent to a storage means, the study section 4 is equivalent to a study means, the image-processing section 3 is equivalent to an extraction means, and the judgment section 5 is equivalent to a judgment means. Moreover, CCD camera 1 and an image memory 2 are equivalent to a picture input means.

[0040] Drawing 2 is drawing showing an example of a hierarchical neural network's composition used with the optical unevenness test equipment of drawing 1 .

[0041] The neural network N of drawing 2 is constituted by the input layer L1, an interlayer L2, and the output layer L3. A neural network's N input layer L1 contains the neuron of the same number as

the number of the kinds of characteristic quantity. Here, two or more characteristic quantity extracted by the image-processing section 3 is set to C1-C7. The characteristic quantity C1-C7 extracted by the image-processing section 3 is inputted into two or more neurons of the input layer L1. An interlayer L2 contains two or more neurons which undergo the output of each neuron of the input layer L1. The output layer L3 contains two neurons which undergo each output of an interlayer's L1 neuron.
[0042] In the neural network N of drawing 2, each neuron which constitutes the input layer L1 plays the role which supplies the characteristic quantity C1-C7 extracted by the image-processing section 3 to each neuron of an interlayer L2, respectively. Each neuron which constitutes each neuron and the output layer L3 which constitute an interlayer L2 consists of a nonlinear element of the many inputs shown in drawing 3, and one output. The input/output relation of the nonlinear element of drawing 3 is expressed by the following formula.
[0043]
Y=f (sigma(i= 1, n) Wi-Xi-S) -- (1)
here -- Xi -- the input value to Neuron ne -- it is -- i= -- they are 1, 2, --, n Wi is a coupling coefficient to each input value, S is a threshold, and Y is the output of Neuron ne. sigma (i= 1, n) means taking total from i= 1 to i=n about the term following the degree.
[0044] In an upper formula (1), the input/output relation of Neuron ne becomes settled by determining each coupling coefficient Wi, threshold S, and function f (x). As function f (x), the logistic function shown, for example in the following formula is used.
[0045]
f(x) =1/(1+exp (-x)) -- (2)
Operation of a neural network N is determined from an upper formula (1) by the coupling coefficient Wi about each neuron and threshold S which constitute each neuron and the output layer L3 which constitute an interlayer L2. The parameter (network parameter) which consists of these coupling coefficients Wi and threshold S is obtained by the study mentioned later. The error back propagation algorithm indicated by the above-mentioned reference is used for study of this neural network N. Hereafter, two neurons of the output layer L3 are called units U1 and U2.
[0046] An example of the relation of the combination of the output value of two units U1 and U2 of the output layer L3 and the judgment result in the neural network N of drawing 2 is shown in drawing 4.
[0047] By this example, as shown in drawing 4, when the output value of a unit U1 is "1" and the output value of a unit U2 is "0", a judgment result is defined as an excellent article, the output value of a unit U1 is "0", and when the output value of a unit U2 is "1", a judgment result is defined as a defective. Moreover, when both the output values of units U1 and U2 are "1", a judgment result is defined as an unknown article, and when both the outputs of units U1 and U2 are "0", a judgment result is defined as an unknown article. In addition, in this example, "11" is used as output desired value of an unknown article at the time of the study mentioned later.
[0048] Next, operation at the time of study of the optical unevenness test equipment of drawing 1 is explained. At the time of study, an inspector performs the judgment of an excellent article and a defective by viewing about the sample for study of dozens - 100 numbers, and inputs into storage 6 with an input unit 7 by making a judgment result into output desired value at it. Moreover, the picture of those samples for study is picturized by CCD camera 1, and the obtained image data is incorporated to an image memory 2.
[0049] The image-processing section 3 extracts two or more characteristic quantity of a kind from the picture of the sample for study based on the image data memorized by the image memory 2, and saves those characteristic quantity at storage 6.
[0050] Drawing 5 and drawing 6 are flow charts which show operation of the study section 4 of the optical unevenness test equipment of drawing 1.
[0051] The study section 4 first reads the output desired value corresponding to two or more kinds of characteristic quantity about two or more samples for study, and each sample for study from storage 6 (Step S1 of drawing 5).
[0052] An example of two or more kinds of characteristic quantity C1-C7 about two or more samples SP1-SPm for study and output desired value is shown in drawing 7. In the example of drawing 7, the output desired value of the samples SP1 and SP2 for study serves as an excellent article, and the

output desired value of the samples SP3 and SPm for study serves as a defective.
[0053] Next, the study section 4 constitutes the hierarchical neural network N who showed drawing 2 , performs study by the error back propagation algorithm using two or more kinds of characteristic quantity about two or more samples for study, and output desired value, and creates the neural network N who has the distinction function of an excellent article and a defective (Step S2). That is, it asks for the network parameter of each neuron of a neural network N.
[0054] Next, the study section 4 multiplies each characteristic quantity about two or more samples for study by the 1st weighting factor for every kind of each characteristic quantity, changes each characteristic quantity, and creates the combination of new characteristic quantity (Step S3). Here, the 1st weighting factor is set as the value (for example, 0.8-0.9) smaller than 1 near 1.
[0055] Next, it judges by inputting each characteristic quantity after change into a neural network N, and the judgment result which shows an excellent article or a defective is obtained (Step S4). And this judgment result is compared with output desired value (Step S5). When a judgment result differs from output desired value, output desired value is transposed to an unknown article (Step S6 of drawing 6).
[0056] When a judgment result is in agreement with output desired value, each characteristic quantity is multiplied by the 2nd weighting factor, each characteristic quantity is changed, and the combination of new characteristic quantity is created (Step S7). Here, the 2nd weighting factor is set as the larger value (for example, 1.1-1.2) near 1 than 1.
[0057] Next, it judges by inputting each characteristic quantity after change into a neural network N, and the judgment result which shows an excellent article or a defective is obtained (Step S8). And this judgment result is compared with output desired value (Step S9). When a judgment result differs from output desired value, output desired value is transposed to an unknown article (Step S10).
[0058] The above-mentioned steps S3-S10 are processed about all the samples for study (Step S11). After processing of Steps S3-S10 is completed about all the samples for study, output desired value becomes three kinds, an excellent article, a defective, and an unknown article.
[0059] An example of two or more kinds of characteristic quantity C1-C7 about two or more samples SP1-SPm for study and the output desired value after correction is shown in drawing 8 . In the example of drawing 8 , the output desired value after the correction about the sample SP 2 for study is transposed to an unknown article, and the output desired value after the correction about the sample SPm for study is transposed to the unknown article.
[0060] Then, study by the error back propagation algorithm is performed using two or more kinds of characteristic quantity of the origin about two or more samples for study saved at storage 6, and the output desired value after correction, and the neural network N who has three kinds of distinction capacity, an excellent article, a defective, and an unknown article, is reconstructed (Step S12). Thus, the reconstructed neural network N is saved at storage 6.
[0061] The detection precision of optical unevenness becomes so low that the amount of noises of CCD camera 1 is large. Moreover, if image processings, such as an image enhancement, are performed, since the amount of noises will also be emphasized, the detection precision of optical unevenness falls. Furthermore, the difference in human being's sensitivity arises according to the kind of optical unevenness. Therefore, the above 1st and the 2nd weighting factor are set up for every characteristic quantity based on the difference between the amount of noises of CCD camera 1, the detection precision in the image-processing section 3, and the sensitivity of human being by the kind of optical unevenness etc. Thereby, weighting is performed for every kind of characteristic quantity.
[0062] An example of the relation between a weighting factor and the rate (misjudgment fixed rate) which an incorrect judging generates is shown in drawing 9 . Generally, since characteristic quantity expresses that the grade of optical unevenness is so large that the value is large, if a weighting factor becomes larger than 1, it will become that it is easy to be judged with a defective. Therefore, the rate which carries out the misjudgment law of the defective to an excellent article becomes high, so that the rate which carries out the misjudgment law of the excellent article to a defective becomes high, so that a weighting factor becomes large and a weighting factor becomes small, as shown in drawing 9 .
[0063] For example, what is necessary is just to use two weighting factors A and B in drawing 9 ,

when transposing the judgment result of the sample for study of C to an unknown article comparatively among the whole sample for study. In this case, first, weighting-factor A is hung and changed to characteristic quantity, the characteristic quantity after change is inputted into a neural network N, and when the neural network's N output value differs from output desired value, the output desired value of the sample for study is transposed to an unknown article. Next, weighting-factor B is hung on characteristic quantity, characteristic quantity is changed, the characteristic quantity after change is inputted into a neural network N, and when the neural network's N output value differs from output desired value, the output desired value of the sample for study is transposed to an unknown article.

[0064] thus, the rate of the sample for study which transposes output desired value to an unknown article becomes possible [the predetermined thing for which a weighting factor is set up so that it may be comparatively alike and may become] among the whole sample for study Consequently, it becomes possible to define the range which judges an excellent article and a defective to be an unknown article.

[0065] Next, operation at the time of inspection of the optical unevenness test equipment of drawing 1 is explained. At the time of inspection, the object 100 to be examined is laid on a transport device 8. The object 100 to be examined is picturized by CCD camera 1, and it incorporates to an image memory 2 by making the acquired picture into image data.

[0066] The image-processing section 3 extracts two or more kinds of characteristic quantity of the object 100 to be examined based on the image data memorized by the image memory 2, and gives those characteristic quantity to the judgment section 5. The judgment section 5 reads the neural network N saved at storage 6, and inputs two or more kinds of characteristic quantity given to the neural network N from the image-processing section 3. And the judgment section 5 performs the judgment of the excellent article of the object 100 to be examined, a defective, and an unknown article based on a neural network's N output value, controls a transport device 8 according to a judgment result, and conveys the object 100 to be examined in a predetermined classification position.

[0067] In the optical unevenness test equipment of this example, since the visual inspection by human being is not needed at the time of inspection, while skill advanced to inspection and a considerable experience become unnecessary, dispersion in the judgment result by an inspector's individual differences or health condition does not arise, and a high-speed judgment is attained.

[0068] Moreover, since a synthetic judgment is made by learning by making the judgment result of the excellent article by human being, and a defective into output desired value, the inspection result near judgment of human being is obtained. Furthermore, since the inspection result as an unknown article is obtained when the judgment of an excellent article and a defective is delicate, an automatic check with few incorrect judgings is realized.

[0069] In addition, although the image-processing section 3, the study section 4, and the judgment section 5 are constituted from an above-mentioned example by each hardware, it is also possible to realize the image-processing section 3, the study section 4, and the judgment section 5 by software on the same CPU (arithmetic and program control). Moreover, it is also possible to separate only the study section 4 from other portions, and to perform exchange of the data between the study section 4 and storage 6 through a network or the external storage which can be removed.

[0070] Moreover, although the 1st weighting factor and the 2nd weighting factor are used in the above-mentioned example in order to change each characteristic quantity, only one of weighting factors can also be used.

[0071] The optical unevenness test equipment and the optical unevenness inspection method of this invention can be applied not only like a shadow mask but like inspection of optical unevenness, such as unevenness of the concentration of sheet-like objects, such as a display panel, a film, and paper, and unevenness of a light transmittance, and can be further applied also to inspection of not only a sheet-like object but the two-dimensional unevenness of arbitrary objects to be examined.

[Claim 1] Optical unevenness test equipment which is characterized by providing the following and which inspects the optical unevenness of an object to be examined. A storage means to memorize the output desired value which shows the excellent article or defective of the characteristic quantity beforehand defined about the picture of two or more objects for study, and each object for study. A neural network is created based on the aforementioned characteristic quantity about two or more aforementioned objects for study and the corresponding output desired value which were memorized by the aforementioned storage means. Perform processing to which the characteristic quantity about each object for study is changed, and the characteristic quantity after processing is inputted into the aforementioned neural network about each object for study. The aforementioned output desired value is corrected by transposing the output desired value about the object for study concerned to an unknown article, when the aforementioned neural network's output value differs from output desired value. A study means to reconstruct a neural network based on the feature value of the origin about two or more aforementioned objects for study memorized by the aforementioned storage means, and the output desired value after correction. An extraction means to extract the characteristic quantity of the picture of an object to be examined. A judgment means to input the aforementioned characteristic quantity extracted by the aforementioned extraction means into the aforementioned neural network reconstructed by the aforementioned study means, and to output the aforementioned neural network's output value as a judgment result which shows an excellent article, a defective, or an unknown article.

[Claim 2] It has further the picture input means which picturizes the aforementioned object for study, or the aforementioned object to be examined, and is given to the aforementioned extraction means by making into image data the picture which incorporated and incorporated the picture. the aforementioned extraction means Based on the image data incorporated by the aforementioned picture input means at the time of study, the characteristic quantity of the picture of the aforementioned object for study is extracted. Optical unevenness test equipment according to claim 1 characterized by giving the extracted characteristic quantity to the aforementioned storage means, and giving the characteristic quantity which extracted and extracted the characteristic quantity of the picture of the aforementioned object to be examined based on the image data incorporated by the aforementioned picture input means at the time of inspection to the aforementioned judgment means.

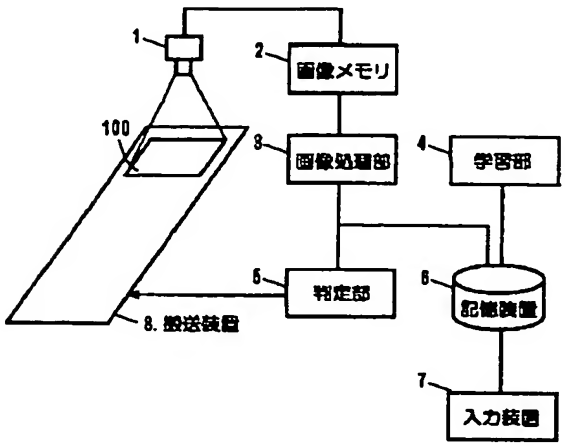
[Claim 3] The processing to which the aforementioned characteristic quantity by the aforementioned study means is changed is optical unevenness test equipment according to claim 1 or 2 characterized by including multiplying the aforementioned characteristic quantity by the predetermined weighting factor.

[Claim 4] The aforementioned neural network formed of it and reconstructed by the aforementioned study means is optical unevenness test equipment according to claim 1, 2, or 3 carry out a bird clapper as the feature from the output layer contain two neurons which receive in the output of two or more aforementioned neurons of the input layer containing two or more neurons equivalent to the number of the aforementioned characteristic quantity, the interlayer containing two or more neurons which undergo the output of two or more aforementioned neurons of the aforementioned input layer, and the aforementioned interlayer, and derive in a binary output, respectively.

[Claim 5] The output desired value which shows the excellent article and defective of the characteristic quantity which is the optical unevenness inspection method of inspecting the optical unevenness of an object to be examined, and was beforehand defined about the picture of two or more objects for study, and each object for study is memorized. A neural network is created based on the aforementioned characteristic quantity about two or more aforementioned objects for study and the corresponding output desired value which were memorized. Perform processing to which the characteristic quantity about each object for study is changed, and the characteristic quantity after processing is inputted into the aforementioned neural network about each object for study. Output desired value is corrected by transposing the output desired value about the object for study concerned to an unknown article, when the aforementioned neural network's output value differs from output desired value. A neural network is reconstructed based on the feature value of the origin about two or more memorized aforementioned objects for study, and the output desired value after correction. The optical unevenness inspection method characterized by inputting into the aforementioned neural network who the characteristic quantity of the picture of an object to be

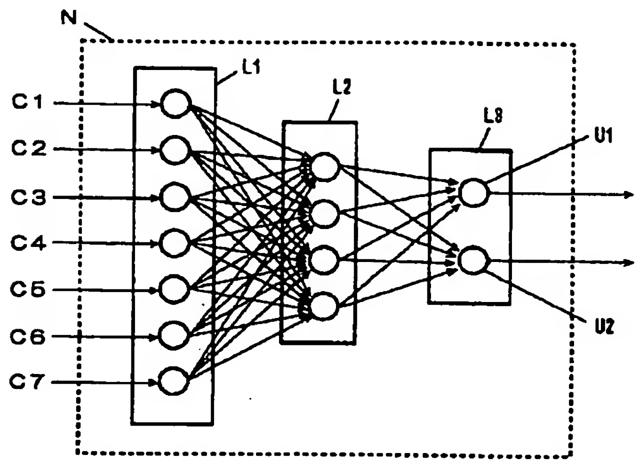
examined was extracted [neural network], and had the extracted aforementioned characteristic quantity reconstructed, and outputting the aforementioned neural network's output value as a judgment result which shows an excellent article, a defective, or an unknown article.
[Claim 6] The processing to which the aforementioned characteristic quantity is changed is the optical unevenness inspection method including multiplying the aforementioned characteristic quantity by the predetermined weighting factor according to claim 5.

Drawing selection drawing 1



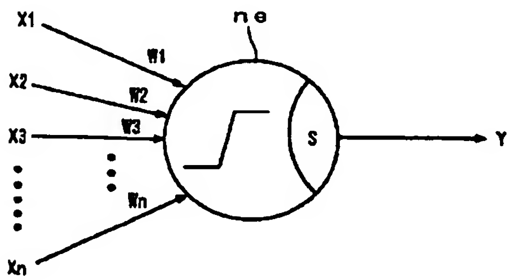
[Translation done.]

Drawing selection drawing 2



[Translation done.]

Drawing selection drawing 3



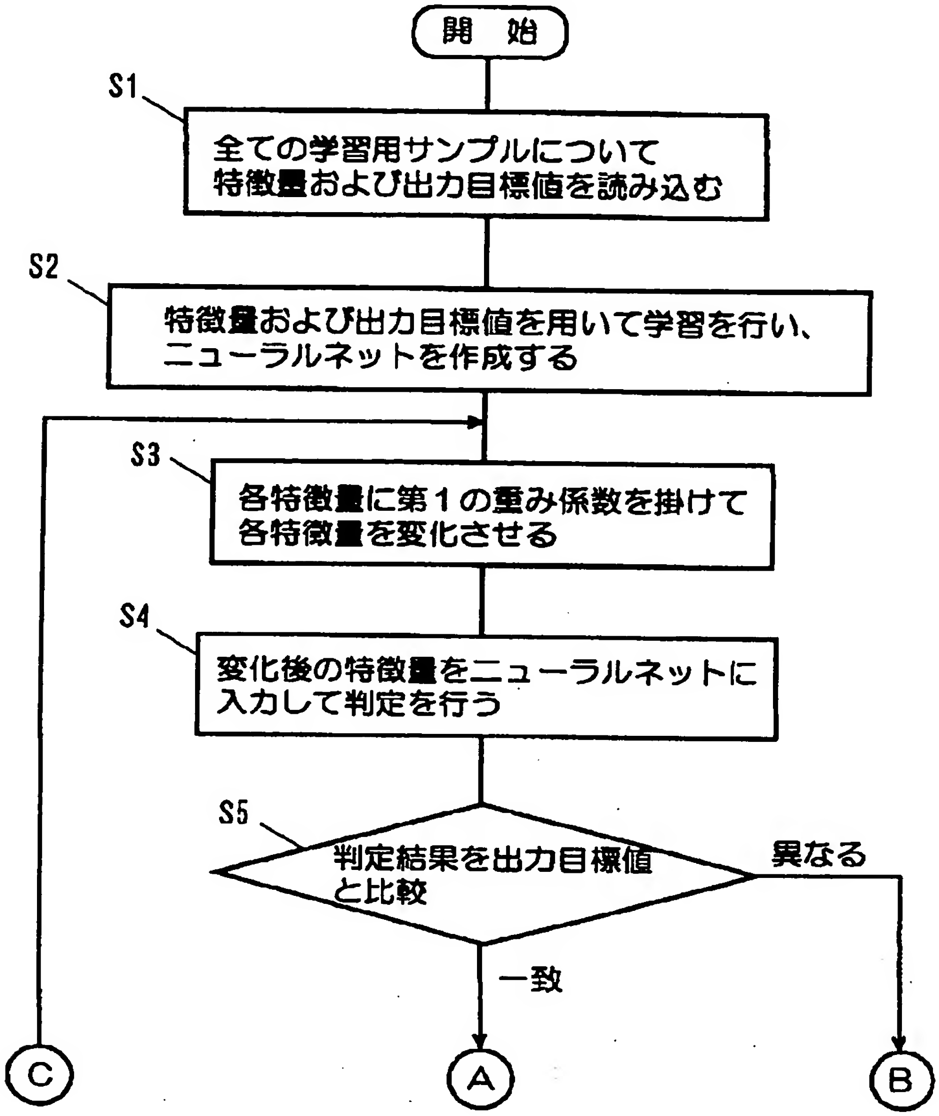
[Translation done.]

Drawing selection drawing 4

ユニットU１の出力値	ユニットU２の出力値	判定
1	0	良品
0	1	不良品
1	1	不明品
0	0	不明品

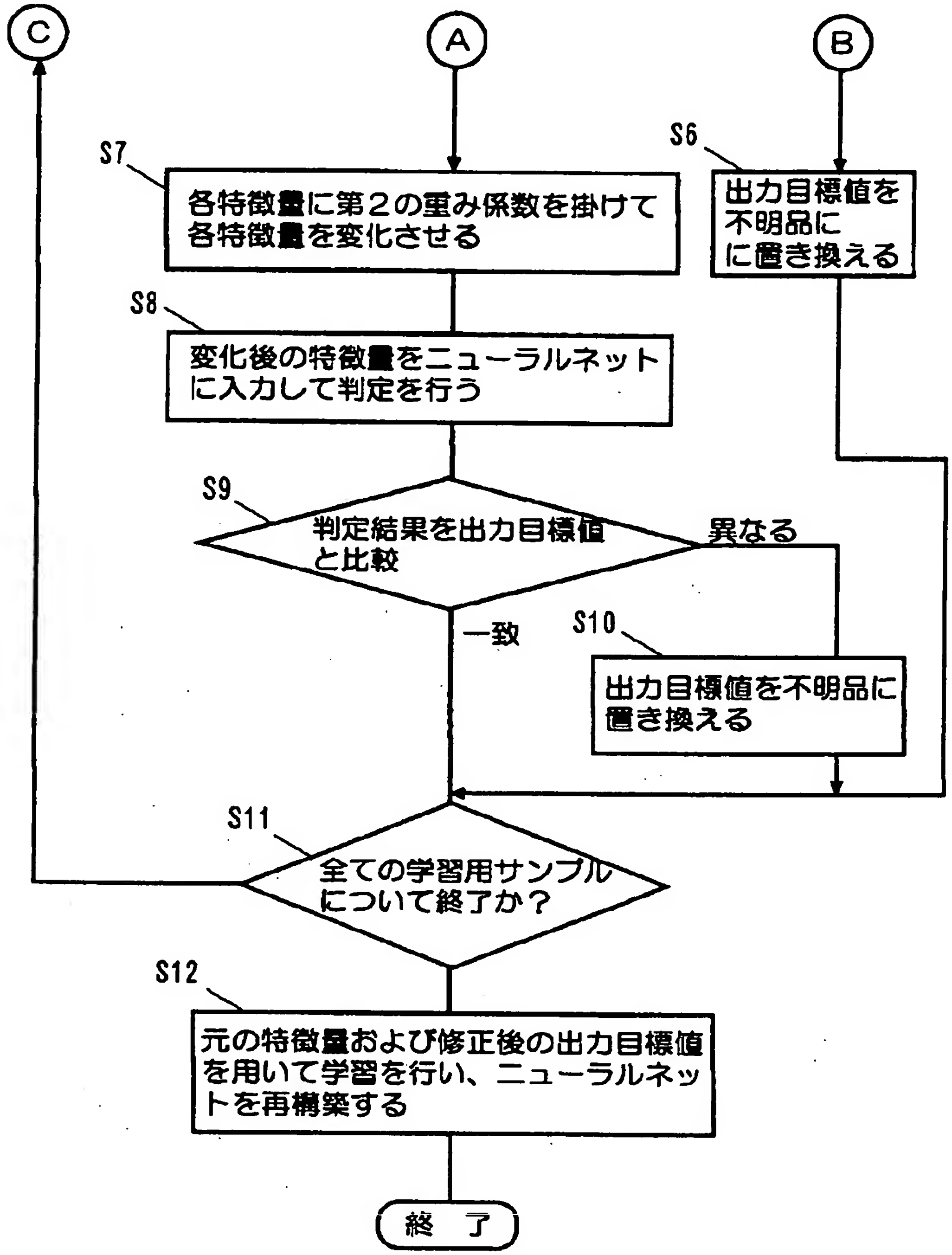
[Translation done.]

Drawing selection drawing 5



[Translation done.]

Drawing selection drawing 6



[Translation done.]

Drawing selection drawing 7

学習用サンプル / 特徴量	SP1	SP2	SP3	・・・	SPm
C1					
C2					
C3					
C4					
C5					
C6					
C7					
出力目標値	1 0 良品	1 0 良品	0 1 不良品	・・・	0 1 不良品

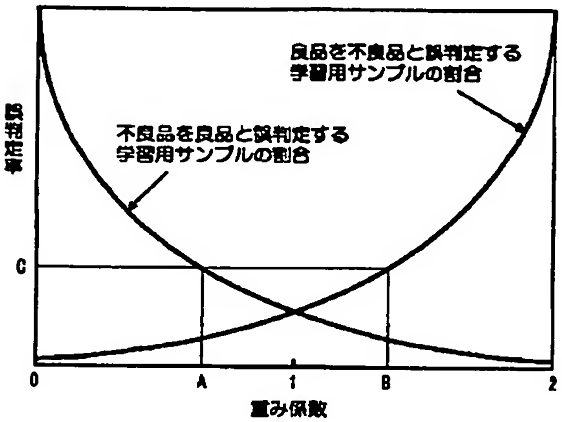
[Translation done.]

Drawing selection drawing 8

学習用サンプル / 特徴量	SP1	SP2	SP3	・・・	SPm
C1					
C2					
C3					
C4					
C5					
C6					
C7					
修正後の出力目標値	1 0 良 品	1 1 不明品	0 1 不良品	・・・	1 1 不明品

[Translation done.]

Drawing selection drawing 9



[Translation done.]